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Impact of tourism development on the local livelihoods and land cover change in the Northern Vietnamese highlands

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Abstract

In the 1990s, some districts in the Northern Vietnamese highlands were opened for international tourism. The development of tourism was expected to bring a new income source to remote mountain areas. This paper analyzes the association between tourism development, local livelihoods and land cover change at the household level. Sa Pa district was selected as a case study. In 25 rural villages within Sa Pa, 487 households were interviewed. This allowed us to classify rural households in three livelihood types: (1) full-time farming, (2) farming with limited involvement in tourism and (3) farming and major involvement in tourism activities. Next, the association between tourism and land cover change at the household level was quantified. The results show that the introduction of tourism increased the living standard of the ethnic minorities and led to more intensive farming systems with forest regrowth on abandoned fields. Nevertheless, the involvement in tourism is location dependent.

Keywords Tourism development · Rural livelihoods · Land abandonment · Ethnic communities · Vietnam · Highlands

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1 Introduction

Poverty and environmental degradation in mountainous sites of developing countries are global concerns in the twenty-first century (Nyaupane and Poudel 2011). Many studies have highlighted the role of poverty on deforestation and biodiversity losses (Adams et al. 2004; Dasgupta et al. 2005; Robinson 2006; Zwane 2007; Jadin et al. 2013; Khuc et al. 2018). Households in remote mountain areas often have no other income source than self-subsistence agriculture, which can lead to an expansion of swidden or permanent cultivation systems when the population increases (Getahun et al. 2013; Vu et al. 2013; Garg 2017). The development of ecotourism is often considered as a sustainable strategy that can generate positive economic benefits for local communities (Adams et al. 2004; Harrison and Schipani 2007; Spenceley and Goodwin 2007; World Tourism Organization 2012; Truong et al. 2014; Adiyia et al. 2017), as off-farm income sources can allow to pull people out of marginal farming (Job and Paesler 2013; Dong et al. 2008).

Recently, the impact of tourism is increasingly been addressed in the international environmental agenda (World Travel Tourism Council 2017; Scott and Selwyn 2010). Hall and Lew (2009) have largely contributed to improve the understanding of the potential effects of tourism, their evaluation and potential management schemes. Asadzadeh and Mousavi (2017) and Gössling (2002) provided an overview of the global environmental consequences of tourism, such as change in land cover and land use, use of energy and its associated impacts, exchange of biota over geographical barriers and extinction of wild species, exchange and dispersion of diseases and psychological consequences including changes in the perception and understanding of the environment. According to Hall and Lew (2009), the development of tourism activities has an impact on people and their physical environment and they, in turn, can affect the further development of tourism.

Nevertheless, the impact of tourism on the well-being of local communities and their environment remains a debatable topic. Tourism can generate off-farm employment that may lead to income diversification that can allow rural households to abandon marginal arable land resulting in forest regrowth. This process was described for Spain (Poyatos et al. 2003; García-Martínez et al. 2011) where tourism led to the abandonment of farmland in the inland Sierras and a migration to the coastal areas. It was also described for Kenya where the intensification of tourism led to less intensive use of land for agricultural purposes (Job and Paesler 2013). Other researchers (Hall 2011; Christ et al. 2003; Hall 2006; Hall and Boyd 2005; Mbaiwa and Kolawole 2013; Worku 2017) suggested that tourism can benefit biodiversity conservation by providing (1) an economic justification and financial support for biodiversity conservation, (2) an economic alternative to other forms of development that negatively impact biodiversity, (3) an improved awareness of the benefits of biodiversity conservation by local inhabitants and (4) the involvement of local people in the maintenance of biodiversity. In term of economics, Beheshti et al. (2017); Raza and Shah (2017) show that by developing of tourism industry, the inequality of income among the provinces will be decreased.

In other cases, direct negative impacts of tourism on the local society and environment were reported. Job and Paesler (2013) and Wiranatha et al. (2017) argue that most of the profits generated through tourism are transferred to other countries' economies. This leakage effect is especially strong if investors from outside take over the organization of the local tourism activities. Other authors reported that the additional income generated through tourism activities, typically arrives with a small minority of the local population (Adiyia et al. 2014). Many households cannot participate in tourism-related activities

because they are located in an inaccessible place, lack appropriate schooling and skills (e.g., languages) or do not have the means for a minimal investment in tourism activities. This can lead to an increasing economic duality in the local society (Michaud and Turner 2006; Stone 2010; Marcouiller and Xia 2008). Also the environmental impact of tourism can be dual. In several cases, it was observed that the development of tourism rather led to environmental degradation and pollution (Obua and Harding 1997; Wong 1998; Wang and Liu 2013; Atik et al. 2010; Mukherjee and Abir 2017; Rasekhi et al. 2016).

Table 1 gives an overview of both positive and negative impacts of tourism on local societies and environment in developing countries, as they were reported in recent studies. These examples show that the relationship between tourism, local livelihoods and mountain environments is dynamic, complex and might be location specific. Contradicting trends are reported which are, moreover, often described in qualitative terms. Quantitative information is, however, of crucial importance as one may expect that in nearly every case positive and negative effects may occur. A quantification of such effects, as well as an understanding of the role of contextual factors, and typology of tourism activities in determining these effects, may assist decision making for sustainable tourism development.

This paper aims to make a quantitative analysis of the association between tourism development, local livelihoods and the induced land cover changes at the household level. Sa Pa district, a highly touristic mountain area in a rapidly developing country (Vietnam), is taken as an example. We seek to quantify this association using detailed household surveys as our basic source of data. We hypothesize that tourism may have a beneficial effect on local livelihoods via two connected pathways. First, tourism allows one to increase wealth by providing additional income. Second, tourism may prevent further environmental degradation, as the additional income will make marginal agriculture on steep lands less attractive, provided that it is sufficiently high to exceed the added value that can be gained from steep land agriculture.

2 Study area

The Sa Pa district is located in Lao Cai province in the northern Vietnamese highlands (Fig. 1). It is a remote, ethnically diverse mountain district ca. 380 km northwest of Hanoi (capital of Vietnam) with a population of 60,276 in 2016 (General Statistics Office Of Lao Cai province 2017). Kinh people (the dominant ethnical group in Vietnam) make up 16% of the total population, and they live almost all in Sa Pa town, the district capital. Almost all of the local non-Kinh population belongs to one of the five following ethnic groups: Hmong (52%), Yao (22%), Tày (6%), Giáy (2%) Xa Phó (1%), while 1% belongs to other non-specified groups (General Statistics Office Of Lao Cai province 2017). The Kinh are mainly involved in administration, tourism and education, while most ethnic minorities practice different variants of subsistence agriculture. The traditional farming livelihood consists of (1) growing rice in paddy fields and maize on upland fields, (2) livestock (mainly pig, chicken and buffalo) and (3) collecting forest products. Recently, many households cultivate cardamom (*Elettaria cardamomum*), a kind of non-timber forest products (NTFPs) under forest canopy. Cardamom has been planted in northern Vietnam for a long time, but it is only emerging as an important cash crop after the ban on opium in 1992 (Tugault-Lafleur and Turner 2009). Cardamom is a spice with medicinal properties and exported to China. The Hoang Lien National Park is located in the southern part of the district (Fig. 1).

Table 1 Overview of local impacts of tourism activities in developing countries, based on a literature review

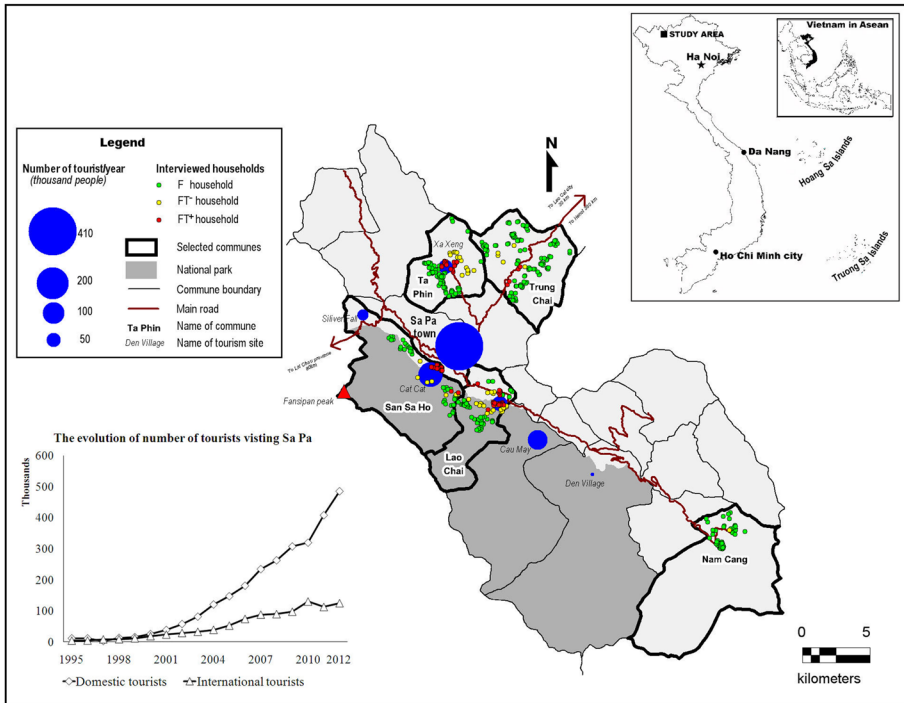|	Positive impacts	Negative impacts
Economic impacts	Generation of foreign exchange earnings and investments (Mitchell 2012; Michaud and Turner 2006)	Leakage effects: tourism uses the local resources, but the generated profits are exported outside the region (Hohl and Tisdell 1995; Job and Paesler 2013; Wiranatha et al. 2017)
	Stimulation of economic diversification and job creation (Butler and Hinch 2007; Iorio and Corsale 2010; Mearns 2012; Adiyia et al. 2017)	Creation of economic inequalities in the local society (Michaud and Turner 2006; Stone 2010; Truong et al. 2014; Truong and Hall 2015)
	Improvement of living standard, poverty alleviation and modernization of rural community (Mbaiwa 2011; Nyaupane and Poudel 2011; Harrison and Schipani 2007; Truong et al. 2014; Adiyia et al. 2017)	
Environmental impacts	Reduced dependence on local natural resources and stimulation of nature conservation (Nyaupane and Poudel 2011; Ballantyne et al. 2009; Worku 2017)	Deforestation due to increased consumption of forest products by tourists (e.g., charcoal) (Gaughan et al. 2009)
		Forest degradation due to building tourist facilities and performing recreational activities within forests (Kuvan and Akan 2005; Wang and Liu 2013; Atik et al. 2010)
	Farmland abandonment and reforestation (Job and Paesler 2013; Dong et al. 2008)	Income from tourism supports for higher frequency of cultivation that lead to further land degradation (Forsyth 1995)
	Tourism is promoted as an economic justification to retain forest cover and reduce deforestation (Mercer et al. 1995; Hall 2011)	Penetration of natural reserves leading to environmental degradation (e.g., loss biodiversity, soil erosion) and pollution (Obua and Harding 1997; Wong 1998; Rasekhi et al. 2016; Mukherjee and Abir 2017)
Sociocultural impacts	Recognition the value of traditional culture (Chang and Yeoh 1999; Mak et al. 2012; Stankova 2015; Şebnem Ertaş et al. 2017)	Social conflicts, crime and degradation of indigenous culture (Wood 1984; Yang et al. 2013; Truong et al. 2014; Devine and Ojeda 2017)
	Change of gender balance with income for women (Scheyvens 2000; Duong 2008; Akyeampong 2011; Ferguson 2011; Ishii 2012; Basurto-Barcia and Ricaurte-Quijano 2017)	

Fig. 1 Location of the study area, distribution and evolution of tourist visits (General Statistics Office Of Lao Cai province 2013) and distribution of interviewed households

The district is situated at the eastern tail end of the Himalayan chain and enjoys a pleasant cool climate. Because of its climate, its unique flora and fauna assemblage and its ethnic diversity, Sa Pa was already a popular resort for foreign visitors under the French colonial period (1912–1954) (Michaud and Turner 2006). Thereafter, the area was not accessible for foreign tourists for a long time due to war and the socialist regime. In 1993, the government decided to reopen the district for international tourism (Michaud and Turner 2006). The tourism sector in Sa Pa really started to flourish from 2002 onwards (Fig. 1) when the road between Lao Cai city and Sa Pa town was improved. The number of domestic and foreign tourists has increased rapidly. In 2012, 610,000 tourists visited Sa Pa (General Statistics Office Of Lao Cai province 2013) (Fig. 1). This growth not only led to a spectacular increase of the number of hotels, restaurants and other facilities in Sa Pa town (Vu and Sato 2010), but likely affected the local livelihoods in rural villages around Sa Pa town. Recently, cardamom cultivation, textile trade and tourism trekking are the foremost cash component of ethnic minorities livelihoods that are otherwise largely subsistence agriculture (Turner 2012b; Turner and Michaud 2009).

In order to evaluate the association between tourism development, local livelihoods and land cover change, 487 interviews were carried out in 25 rural villages belonging to five communes (Fig. 1). Communes were selected based on their accessibility to Sa Pa town and the actual influence of tourism. The communes of Ta Phin, San Sa Ho and Lao Chai are located in close neighborhood of the tourism center (Sa Pa town), whereas

the communes of Trung Chai and Nam Cang are more isolated. Table 2 gives a short description of each of the five selected communes.

3 Materials and methods

3.1 Household interviews

Tables 3 and 4 give an overview of the variables for which information was collected by means of semi-structured interviews. The interviewed households were selected randomly from the list of household heads from the Vietnam Rural, Agricultural and Fishery Census of 2006. As household interviews require a lot of manpower, we decided to aim at a random sample of 20 households per village in 25 villages. In some cases, the interviews were not completed because of language problems or a sudden interruption of the interview. As the complete interviews were analyzed, the final dataset consisted of a total of 487 households comprising 3193 individuals which corresponds with 21% of the total population of 15,300. This sample can be considered as a representative and is also in agreement with the size of similar interview-based studies in the mountain areas (Mbaiwa 2011; Meyfroidt and Lambin 2009; Hoang et al. 2014). The interviews were carried out in the summer of 2012 by 16 interviewers, split up in 8 groups of 2. All interviewers were trained in survey and interviewing techniques. Each interview was carried out in Vietnamese, and it took approximately 1–1.5 h. In the rare case that respondents did not speak Vietnamese fluently, village heads acted as translator. The location of each household was registered with a handheld GPS. The accessibility of each household was assessed by measuring the travel time to the district center (Sa Pa town) and nearest tourism attraction using a cost distance procedure in ArcGIS 9.3 that takes the road network and road types (footpath, gravel road and asphalt road) into account.

3.2 Clustering livelihoods

The degree to which rural households are involved in tourism and the income that they generate from it vary widely. Broadly, three types of households may be distinguished based on the household surveys: (1) full-time farming (type F), (2) farming with limited involvement in tourism (type FT^-) and (3) Farming with major involvement in tourism activities (type FT^+). The interviewed households were grouped in three classes by means of a k-means cluster analysis (XLSTAT software 2014) on the basis of following variables: *number of household members engaged in tourism, tourism income, tourism investment.*

In order to interpret the clusters, the Y-values describing the deviation between the cluster average and the overall average were calculated as follows:

$$Y = (X_k - X)/X \tag{1}$$

With X_k = average of the variable x within cluster k, X = average of variable x. Positive Y-values for a cluster indicate that a specific variable has higher than average scores.

Next, for each household type, flux diagrams were composed that show the major sources of income and expenses. Significant differences in income and expenditure structure, agricultural yield, farmland area, travel time to Sa Pa town and travel time to the nearest tourism attraction of the different household clusters were identified by means of Mann–Whitney–Wilcoxon tests.

Table 2 Overall characteristics of the five selected communes within Sa Pa district

Name of commune	Number of villages	Ethnic group	Population 2010[a]	Accessibility	Number of tourist visits[b]	% of employment in tourism[c]	Located in Hoang Lien National Park?	Number of interviews	
								Interviewed households	% of households
Trung Chai	7	Hmong and Yao	3660	12 km from Sa Pa town by asphalt road	0	5.8	No	135	23.6
Ta Phin	6	Hmong and Yao	2878	12 km from Sa Pa town by asphalt road	52,480	16.0	No	116	25.8
San Sa Ho	4	Hmong	3824	2 km from Sa Pa town by asphalt road	125,870	19.6	Yes	77	14.1
Lao Chai	5	Hmong	3414	8 km from Sa Pa town (6.5 km on asphalt road and 1.5 km on gravel road)	50,430	22.2	Yes	100	18.8
Nam Cang	3	Hmong and Yao	1524	42 km from Sa Pa town (33 km by asphalt road and 9 km by gravel road)	0	1.1	No	59	24.8

[a]National Vietnamese Census, Year book in 2010 (General Statistics Office Of Vietnam 2010)

[b]Tourism annual report of Sa Pa district in 2009 (Department of Commerce and Tourism of Sa Pa district 2009)

[c]Derived from household interviews carried out in the summer of 2012

Table 3 Key information from household surveys (hh) describing composition of households, involvement in tourism activities and history of their settlement

Items	Class	Unit	Number of sample	Percentage of sample
Gender of household members	Male	Person	1532	48.0
	Female		1661	52.0
Age of household members	0–15	Person	1219	38.2
	15–60		1835	57.5
	> 60		139	4.3
Ethnicity of households	Hmong	Household	355	72.9
	Yao		127	26.1
	Other		5	1.0
Involved in tourism activities	Involvement	Household	122	25.1
	Non-involvement		365	74.9
Reasons for not involved in tourism activities	Inaccessibility	Household	227	62.2
	Language barrier		74	20.3
	Lack of labor		32	8.8
	Lack of capital		25	6.8
	Prejudice		7	1.9
Time since when hh is living in Sa Pa	< 20 years	Household	63	12.9
	20–40 years		26	5.3
	> 40 years		398	81.8

3.3 Analysis of the controls on land cover change

In order to assess the association between tourism development and land cover changes, our research was carried out at two levels (village and household level). Firstly, land cover changes at village level were mapped from remote sensing data in order to give an overview of land cover change trajectories after the development of tourism. Two land cover maps were compiled for the years 2002 and 2012. The land cover map of 2002 was constructed based on aerial photographs at a scale of 1/47,500. The land cover map of 2012 was based on VHR-SPOT 5 satellite images (2012) with a spatial resolution of 2.5 m by 2.5 m. All imagery was made available by the Ministry of Natural Resources and Environment (MONRE 2002, 2012). The VHR-SPOT image was available in an orthorectified and georeferenced format. The aerial photos were orthorectified and geo-referenced using the Photomod software (Racurs 2009). Next, the digital information of all images (2002, 2012) was segmented using image segmentation in the eCognition Professional 6.0 software. This step aims at segmenting the digital image into a set of non-superimposable, discrete regions on basis of their internal homogeneity (Ruelland et al. 2011; Devereux et al. 2004). Finally, land cover maps were produced by grouping the segments on the basis of visual interpretation into eight categories: (1) closed canopy forest, (2) open canopy forest, (3) terraced paddy fields, (4) upland fields, (5) shrub, (6) residential area, (7) river and (8) road. The accuracy of the land cover map based on the VHR-SPOT image of 2012 was assessed by comparing the classified land cover with field observations. As we do not have validation data for the land cover map of 2002, we assume that the accuracy of the land cover map based on aerial photographs

Table 4 Summary of the quantitative variables that were used in the statistical analyses

	Variable	Variable type	Categories	Unit
Household characteristics	Household size	Integer		Person
	Number of hh members engaged in tourism	Integer		Person
Evolution of Arable land 2002–2012	Evolution of paddy fields at household level	Nominal	Expansion	'1' for expansion
			Decrease	'0' for no change or decrease
			No change	
	Evolution of the upland fields at household level	Nominal	Expansion	'1' for abandonment
			Abandonment	'0' for no change or expansion
			No change	
(I) Off-farm income	Tourism income	Continuous		kVND/year
	Other cash income (remittance, hired labor, salary, business,…)			
(II) Agricultural income[a]	Wet rice income	Continuous		kVND/year
	Swidden rice income			
	Corn income			
	Other crops income			
	Livestock income			
(III) Non-timber forest products (NTFPs) income	Cardamom income	Continuous		kVND/year
Total HH income = I + II + III	Total income	Continuous		kVND/year
Investment in agriculture	(a) Rice seeds	Continuous		kVND/year
	(b) Corn seeds			
	(c) Pesticides, herbicides			
	(d) Chemical fertilizer			
	(e) Other agricultural costs			
	Total agricultural investment = a + b + c + d + e			
Investment in tourism		Continuous	kVND/year	

Table 4 (continued)

	Variable	Variable type	Categories	Unit
Annual living expenses	(f) Rice bought amount	Continuous		kVND/year
	(g) Education			
	(h) Electricity			
	(i) Other living expenses			
	Total living expense = f + g + h + i			
Accessibility[b]	Travel time to Sa Pa town	Continuous		Minute
	Travel time to the nearest tourism attraction	Continuous		Minute

Socioeconomic data were extracted from the 487 household surveys (hh), while the accessibility information was calculated using a cost distance analysis in GIS

[a] Agricultural incomes are defined as the sum of cash income and market value of subsistence products

[b] The accessibility was calculated in a GIS system using a cost distance analysis

is similar as the one obtained from the VHR-SPOT image, given the higher spatial resolution of the aerial photographs. For each category, land cover change was measured by map comparison.

In the ideal case, data on the exact location of all the parcels belong to the individual households were available, but since no cadastral information is available for the villages it was impossible to link parcels with families. Therefore, we developed two binary variables for each household by asking very explicitly the following questions:

1. Did you abandon land in the past 5 years (yes/no)?
2. Did you expand your paddy fields in the past 5 years (yes/no)?

This resulted in the variables 'Land Abandonment (LA)' and 'Expansion of Paddy Fields (EPF)' which were coded as '1' if the considered land use change took place and '0' if the land use change did not take place.

Variables LA and EPF were then considered as dependent variables and were linked with predictors derived from the interviews through multiple logistic regression (MLR).

The considered predictors (listed in Table 4) are: *household size, number of hh members engaged in tourism, tourism income, total agricultural income, NTFPs income, agricultural investment, tourism investment, living expenses, accessibility.* A multicollinearity test was carried out to detect correlation between explanatory variables. Multicollinearity diagnostics were performed by calculating the variation inflation factors (VIF) and the tolerance (TOL). In this study, variables with VIF greater than 2 and TOL less than 0.6 are excluded from the analyses as proposed by Allison (1999). The final models included the following variables as predictors for LA and EPF probabilities: *household size* (HSIZE), *tourism income* (TINCOME), *NTFPs income* (FINCOME), *agricultural income* (AINCOME), *agricultural investment* (AINVEST), *living expenses* (LIVEXP) (Table 4), resulting in the following equations:

$$P(LA \text{ or } EPF) = \frac{e^{(a+b_1*HSIZE+b_2*TINCOME+b_3*FINCOME+b_4*AINCOME+b_5AINEST+b_6*LIVEXP}}{1+e^{(a+b_1*HSIZE+b_2*TINCOME+b_3*FINCOME+b_4*AINCOME+b_5AINEST+b_6*LIVEXP}}$$

(2)

whereby: P(LA) = the probability that a household abandoned upland fields and P(EPF) = the probability that a household expanded paddy fields. Parameters a, and b_1, …,b_6 were calibrated following a maximum likelihood procedure implemented in the XLSTAT software. Positive values for the coefficients b_i imply that an increase in the value of the corresponding explanatory variable results in an increase of the probability of dependent variables and vice versa. Both for the LA model and the EPF model, a random sample of 367 households was selected for model calibration. The remaining 120 households were used for model validation. The accuracy of the MLR-model was assessed by the 'Relative Operation Characteristics' (ROC) (Fawcett 2006). In this procedure, the percentage of 'true positives' for a certain probability threshold was plotted against the percentage of 'false positives' that results in a ROC-curve. The ROC-value is defined as the area under the ROC-curve (AUC). A significant model is a model that is better than a random model and has a AUC-value higher than 0.5 (Pontius and Schneider 2001).

4 Results and discussion

4.1 Profile of the interviewed households

The survey results show that the study area is characterized by a young population with 38% below working age (0–15 years old), 58% in working age (15–60 years old) and only 4% over working age (>60 years old). Most of the respondents belong to Hmong and Yao ethnic groups, accounting for 73% and 26%, respectively. All interviewed households are involved in agricultural activities, and 25% of them are to some extent involved in tourism activities (Table 3). This involvement corresponds with 13% of total labor activities in terms of jobs. Table 2 shows that the variability in tourism involvement between the communes was significantly controlled by distance from Sa Pa town. The interviewed households mentioned accessibility of their village and language barriers as the main reasons for not involving into tourism (occupy 62% and 20% of interviewed households that did not involve in tourism, respectively) (Table 3). The remaining 18% of the households mentioned other reasons such as lack of time for tourism activities (7.7%), lack of capital for tourism activities (6.7%), lack of knowledge for tourism activities (3%) and aversion to tourism (0.6%). This is consistent with research of Truong and Hall (2015) that indicated that lack of business knowledge, education, capital and access to information are barriers to local people who want to participate in tourism. Although the communes Trung Chai and Ta Phin are located at the same distance from Sa Pa town (Table 2), very few tourists visit Trung Cai because the terrain is so rough that it is hardly accessible. In addition, there are cultural elements that play a role. Local people in Trung Chai are known to be more conservative toward outdoor employment of women that typically run the tourism activities.

Of all the villagers involved in tourism, 61% sell crafts and other handmade items (Fig. 2b, c) generating an average income of 740 USD/year, 22% produce crafts generating an average income of 380 USD/year, while 8% of them work as a tour guide generating an average income of 1022 USD/year and 5% has a job in the hotels and restaurants generating an average income of 997 USD/year. The remaining 4% is involved in other tourism activities such as taxi driver and porter. There is a clear difference between men and women: 80% of villagers that participate in tourism are women that make and sell crafts, act in cultural performances, and work in restaurants or as a tour guides. Men are much less involved. They generally work as porters on mountain hikes or motorbike taxi drivers. Villagers that are (partially) employed in tourism are on average quite young, especially the tour guides, porters and cultural performers (under 30 years old).

4.2 Tourism and the way of living of local villagers

The results of the cluster analysis are shown in Fig. 3. The first cluster (F) consists of households that are full-time working in agricultural activities with (almost) no involvement in tourism activities, often because they live in remote places. They are concentrated in the communes of Nam Cang and Trung Chai, but are also found in remote villages of other communes (Fig. 1). The average travel time (by motorized vehicle) of an F-household to Sa Pa town is 45' and is about 39' to the nearest tourism attraction (Table 5). F-households produce staple crops such as wet rice and corn mainly for feeding their household. Some of them cultivate cardamom under forest canopy as cash crop. On average, F-households generate a total annual income of 2095 USD/year. Most of the agricultural production is
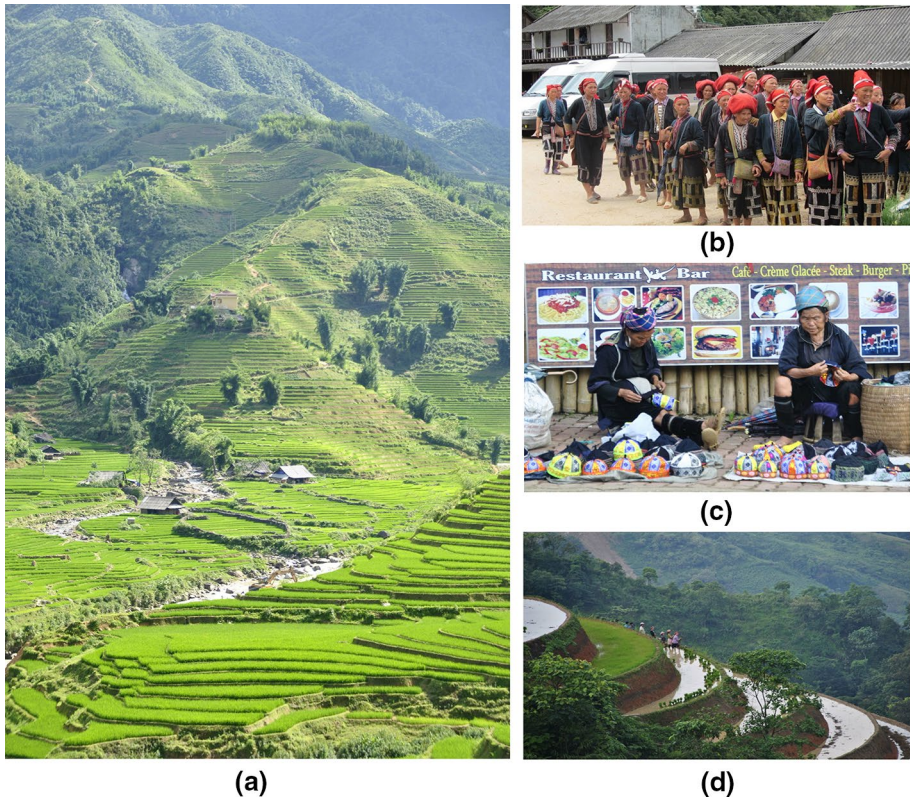
Fig. 2 Pictures illustrating the natural and cultural landscape of Sa Pa district: **a** Terraced paddy fields on steep slope, **b** Yao women in Xa Seng village (Ta Phin commune) waiting for tourists coming to their village to sell handicrafts, **c** Hmong women selling crafts in Sa Pa town, **d** local farmers transplanting rice on paddy fields (Source: first author in 2012)

consumed within the household, while the non-timber forest products (NTFPs) (mainly cardamom) generate an average cash income of 820 USD/year.

The second cluster (FT⁻) consists of households that are adopting a farming livelihood, but generate a lower income from their farming activities because they have less arable land and less means to invest in intensification. Households in this cluster often sell handicrafts in the streets that generate a limited and unstable additional income (Truong and Hall 2015). FT⁻-households live in more accessible places (Fig. 1) that are frequented by a limited number of tourists, which allows the households to produce and sell ethnic crafts. Their average travel time (by motorized vehicle) is 28' to Sa Pa town and 19' to the nearest tourism attraction (Table 5). Their location is, however, a limiting factor for taking up a part-time employment in the tourism facilities of Sa Pa town. The added value of craft production is relatively low resulting in an average additional income of ca. 368 USD/year on top of their average farming and NTFPs income of 1126 USD/year, resulting in an average total income of 1885 USD/year of which 1144 USD is cash income.

The third cluster (FT⁺) consists of relatively rich households adopting a diversified livelihood strategy with farming activities and a major involvement in tourism activities resulting in various income sources. Because of their location nearby the district capital and
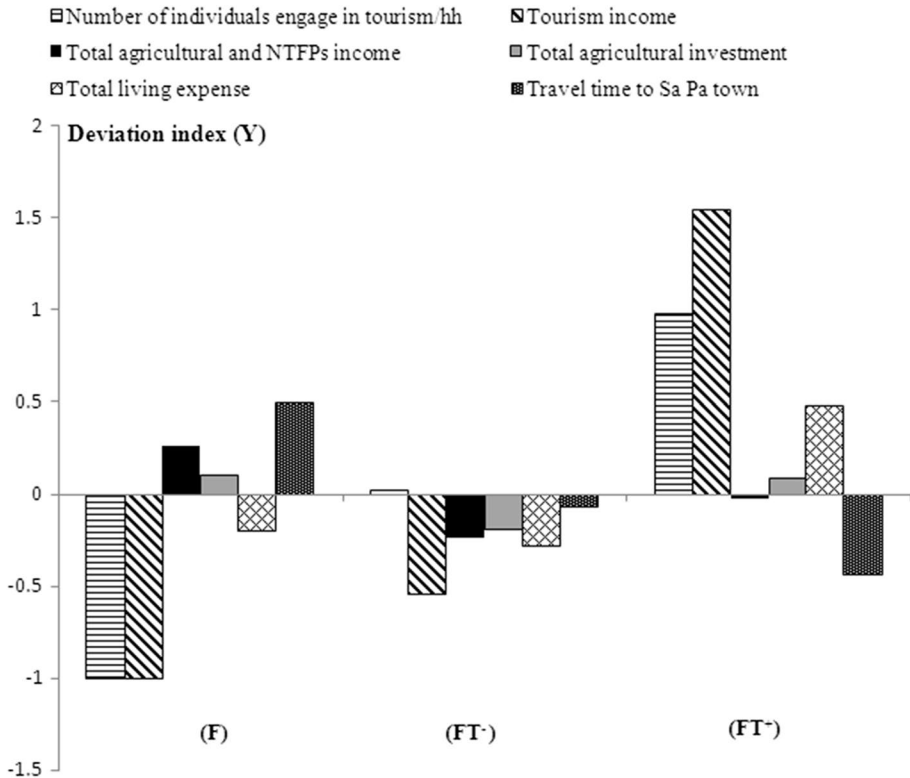
Fig. 3 Profile of the detected livelihoods: (F) full-time farming households with no involvement in tourism activities, (FT⁻) farming households with limited involvement in tourism, (FT⁺) farming households with major involvement in tourism

touristic attractions (average travel time is 17' to Sa Pa town and 6' to nearest tourism attraction (Fig. 1; Table 5), many household members have a full-time job as salesperson of traditional crafts, tour guide or servant in the tourist facilities. In some cases, households invested in their own homestay business. On average, FT⁺-households receive an income of 1447 USD/year from farming and forestry practices, which is slightly lower than F-households. An additional income of 2047 USD/year is generated from tourism activities resulting in an average total income of 3750 USD/year of which 2823 USD is cash income. The additional income from tourism allows several households to diversify their farming activities with breeding trout and local varieties of pig and chicken; growing fruit trees and flowers (Nguyen 2010; Nguyen 2006) which require technical know-how and significant investments only affordable for the FT⁺ households. Part of this production is consumed by the incoming tourists, while part is exported to Hanoi and abroad.

Nonparametric Mann–Whitney–Wilcoxon tests were carried out to detect possible differences in income and expenditure patterns, agricultural yield, farmland area and accessibility between the three household types (F, FT⁻ and FT⁺) (Table 5). The results show that FT⁺-households are significantly richer than F and FT⁻ -households, because of their additional tourism income. FT⁺-households cultivate less land but invest significantly more in chemical fertilizers resulting in a higher crop yield of paddy fields

Table 5 Results of comparison tests between three different livelihood types for income and expenditure patterns, agricultural yield, farmland area and accessibility variables

Item	Variables	Mean value			Comparison	p value
		Full-time farming (F)	Farming with limited involvement in tourism (FT⁻)	Farming and major involvement in tourism activities (FT⁺)		
Household income (USD/hh/year[a])	**Total income**	2095	1885	3750	FT⁺ > F	<0.001
					FT⁺ > FT⁻	<0.001
	Tourism income	0	368	2047	FT⁺ > FT⁻ > F	<0.001
	Agricultural income	1054	861	1165	F > FT⁻	0.006
					FT⁺ > FT⁻	0.080
	Cereals income	986	741	927	F > FT⁻	0.027
	Cattle income	32	81	163	FT⁻ > F	0.003
					FT⁺ > F	0.027
	Other crops income	36	39	75	Not significant	
	NTFPs income	820	265	282	F > FT⁻	0.002
					F > FT⁺	0.018
	Other cash income	221	391	256	Not significant	
Annual living expenses (USD/hh/year[a])	**Total living expense**	578	517	1063	FT⁺ > F	<0.001
					FT⁺ > FT⁻	<0.001
	Rice bought	38	55	57	FT⁻ > F	0.056
	Education cost/child	90	36	107	FT⁺ > F	0.045
					FT⁺ > FT⁻	0.027
	Electricity cost	22	23	42	FT⁺ > F	<0.001
					FT⁺ > FT⁻	0.005
	Other living expense	428	403	857	FT⁺ > F	<0.001
					FT⁺ > FT⁻	<0.001

Table 5 (continued)

Item	Variables	Mean value			Comparison	p value
		Full-time farming (F)	Farming with limited involvement in tourism (FT⁻)	Farming and major involvement in tourism activities (FT⁺)		
Agricultural investment (USD/ha/year[a])	*Total agricultural investment*	778	569	766	F>FT⁻ FT⁺>FT⁻	0.050 0.098
	Herbicide, pesticide	19	13	11	F>FT⁻ F>FT⁺	0.098 0.016
	Chemical fertilizer	184	155	217	FT⁺>FT⁻ FT⁺>F	0.030 0.070
Tourism investment (USD/hh/year[a])	Tourism investment	0	224	327	FT⁺>FT⁻>F	0.041
Farmland area[b] (ha)	Paddy fields	0.43	0.35	0.41	F>FT⁻	0.100
	Upland fields	0.35	0.23	0.29	F>FT⁻ FT⁺>FT⁻	0.090 0.100
Agricultural yield (ton/ha)	Rice production	4.0	3.5	4.6	FT⁺>F>FT⁻	0.053
	Corn production	2.8	2.3	2.7	F>FT⁻	0.056
Accessibility (min)	Travel time to Sa Pa town	45	28	17	F>FT⁻>FT⁺	<0.001
	Travel time to nearest tourism site	39	19	6	F>FT⁻>FT⁺	<0.001

[a] Monetary unit used during the interview is kVND then converted into USD for analysis. At the moment of the fieldwork, 1 USD corresponded with ca. 20 kVND

[b] Area of farmland is measured via amount of seed sown with 1 kg of rice seed is equal to 0.03 ha and 1 kg of corn seed is equal to 0.06 ha

than F and FT⁻-household. Table 5 shows that FT⁻-households receive a lower income from farming than the FT⁺ and F-households because they do not generate sufficient cash income from tourism for investing in fertilizer such as the FT⁺-households. Both the FT⁻and FT⁺-households specialize to a certain extent in cattle breeding, while the F-households generate a large part of their income from cardamom cultivation. FT⁺-households can adopt higher living standards and have modern equipment resulting in higher expenses for electricity. FT⁺-households also invest significantly more in the education of their children by sending them to secondary schools in Sa Pa town and higher education in Lao Cai city or Hanoi.

Figure 4 is a conceptual diagram summarizing the income and expenditure structure of the three livelihoods showing the available land, labor and the fluxes of capital input and output. From these observations, we can conclude that the introduction of tourism has an important impact for a number of families. Tourism improves their living standards and steers the farming practices toward diversification and intensification. This research supports earlier arguments that tourism makes a contribution to poverty alleviation (Mbaiwa 2011; Nyaupane and Poudel 2011; Truong et al. 2014). The results from this study show, however, that only a limited group of households benefits from the development of tourism. Households engage successfully in the tourism sector only if they live nearby the major tourism attractions. Participation from a remote location typically results in a FT⁻ livelihood whereby tourism activities are part of a survival strategy of poor households, without improving fundamentally the living standards.
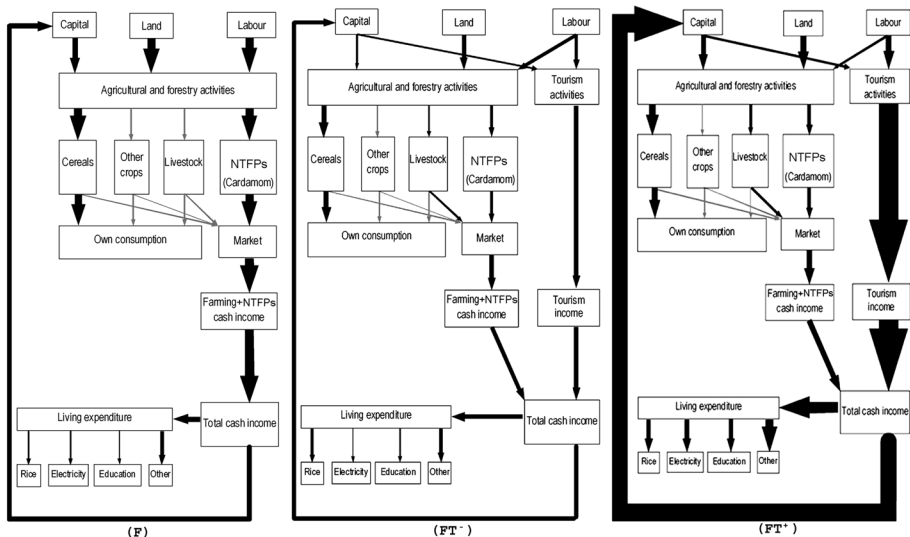

Fig. 4 Schematic overview of the detected livelihoods in the study area: (F) full-time farming, (FT⁻) farming with limited involvement in tourism, (FT⁺) farming and major involvement in tourism activities. (The width of the arrows indicates the relative importance of the fluxes of labor and capital for each livelihood type based on the household surveys)

4.3 Tourism and land cover change

Figure 5 shows the observed land cover changes between 2002 and 2012 from remote sensing data. The overall accuracy of the land cover map of 2012 was 86.4% (kappa value of 0.84). The major changes are an increase in the forest area (closed canopy forest (+1.5%); opened canopy forest (+2%)) and a decrease in upland fields (−1.3%) and shrubs (−2%). A little increase in residential area (+0.1%) and decrease in paddy field (−0.3%). A net increase in the forest area is detected in four communes (Ta Phin, San Sa Ho, Lao Chai, Nam Cang). In the commune of Trung Chai, deforestation and reforestation rates are similar. The decrease in upland fields and shrubs is linked with the reduction in swidden cultivation (Castella et al. 2005). Most swidden fields have been left fallow to regenerate into forest in order to create the necessary ecological conditions to plant cardamom (Sowerwine 2004b). A limited number of them were converted to permanent terraced fields.

To evaluate whether the observed land cover changes are related to the development of tourism, multiple logistic regression were calibrated at household level. Table 6 shows the calibrated MLR-coefficients for both the land abandonment model and the paddy field expansion model. An ROC validation (Relative Operation Characteristics validation) showed that both models have a significant predictive power with AUC-values > 0.70. The results show that probability of land abandonment is positively related with tourism income, with NTFPs income (cardamom income) and agricultural income. The probability of paddy field expansion is positively related with household size and agricultural investment. The results suggest that the households that are gaining additional income from tourism or cardamom cultivation can afford to abandon less productive land. These households typically intensify farming activities on the remaining fertile land and invest significantly in paddy field expansion if the household size increases. As the land available for paddy field expansion is limited in Sa Pa district, richer households can acquire paddy fields from other farmers. Our data also show that a large number of households participate in farming and tourism activities, but do not generate sufficient income to abandon farming land or invest in terraced field expansion. Recent research in Sa Pa shows that this is a significant and long-term trend. Burkhard et al. (2015) indicated that the growing tourism is the main
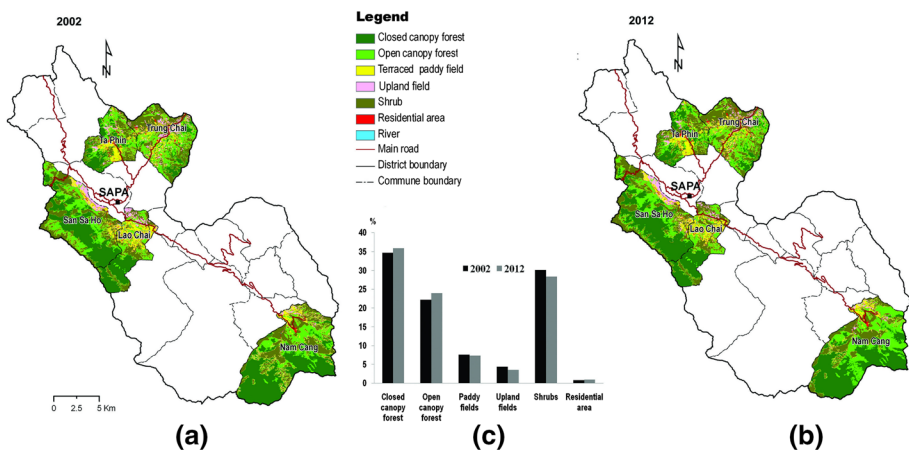

Fig. 5 a Land cover map in 2002, **b** land cover map in 2012 and **c** proportions of the main land cover classes in 2002 and 2012 of 5 selected communes

Table 6 Results of the multiple logistic regression, with significant explanatory variables in bold

LUC categories	Controlling factors	Regression coefficients	Standard error	Pr > Chi²	MPV	MPI	Power of the model (ROC-value)
Land abandonment	Intercept	− 1.648,041	0.376	< 0.001			**0.75**
	Tourism income	0.000009	0.000	0.069	300000	2.7	
	NTFPs income	0.000007	0.000	0.093	420000	2.9	
	Agricultural income	0.00001	0.000	0.003	107800	1.1	
	Agricultural investment	− 0.000089	0.000	0.196	30000	NS	
	Total living expenses	0.000001	0.000	0.888	91090		
	Hh member	− 0.004609	0.052	0.930	20		
Paddy field expansion	Intercept	− 0.880101	0.321	0.006			**0.71**
	Hh member	0.093453	0.048	0.052	20	1.8	
	Agricultural investment	0.000079	0.000	0.058	30,000	2.4	
	Tourism income	− 0.000002	0.000	0.706	300,000	NS	
	NTFPs income	− 0.000001	0.000	0.774	420,000		
	Agricultural income	0.000007	0.000	0.395	107,800		
	Total living expenses	0.000006	0.000	0.487	91,090		

NS not significant

source of income here. Rice is grown only in the form of subsistence farming, and no market exists within the grasp of local people. New terraces are created, while others have been abandoned.

The coefficients of the logistic regression allow to determine the most important controlling factors by multiplying the maximum value of each variable in the dataset (MPV) with its regression coefficient (Guns and Vanacker 2012). This measure of parameter importance (MPI) indicates that NTFPs income (cardamom) and tourism income are the most important variables related to land abandonment, while agricultural investment is the mostly related to paddy field expansion (Table 6). Reforestation and land abandonment in Sa Pa district is related to a livelihood diversification associated with tourism development and cardamom cultivation. Households that were able to diversify their income because of tourism-related activities are characterized by a reworking of the gender relations (Bonnin and Turner 2013). The development of tourism activities mainly offered new off-farm opportunities for women from ethnic minorities, having as a direct consequence that women are now less involved in agricultural activities, while men are more involved into household management (Hoang et al. 2014). As there is less labor available for agricultural activities, cutting or clearing of trees, marginal agricultural fields with low productivity are preferentially abandoned and deforestation and forest degradation are reduced. Our data suggest that the additional income from tourism is sufficiently high to exceed the added value that can be gained from steep upland agriculture or from forest extraction. The fallowed fields regenerate into forests that can develop the optimal ecological conditions for cardamom cultivation (Sowerwine 2004b). Dang et al. (2018) also revealed that one-third of the area of paddy fields in the case study area have 'no' capacity to supply natural hazard regulating ecosystem services and should therefore be re-forested.

At the same time, both the qualitative data from the interview as the quantitative logistic regression analysis show a clear and significant connection: households involved in tourism tend to abandon their marginal fields and intensify on their prime agricultural land. Very often, the income from tourism is invested in agricultural modernization such as the application of chemical fertilizers and pesticides, and acquisition and sowing of high productive hybrid rice and corn breeds. This modernization of agricultural practices has been encouraged by the Vietnamese government since 1990 (Bonnin and Turner 2012; Turner 2012a; Tekken et al. 2017), but was only widely adopted in the area when additional cash income from off-farm activities such as tourism became available. On average, the yield of wet rice crops went up from 2.3 ton/ha in 1990–4.6 ton/ha in 2010 (General Statistics Office Of Vietnam 2010) in Sa Pa district. The guaranteed food security resulted in an accelerated abandonment of swidden rice cultivation (Sowerwine 2004a). Tekken et al. (2017) also showed that most farmers had shifted from traditional cultivars to modern high yielding varieties that had an influence on sociocultural structures and land use change in the study area.

5 Conclusions

Tourism can have an important impact on the way of living of rural households. Our study in the Northern Vietnamese highlands shows that there are two types of rural livelihoods that are relatively successful in the Sa Pa district. The first one is a rural livelihood based on agricultural activities, whereby extra cash is generated from cardamom cultivation. Here, a tendency toward agricultural intensification was observed. The second one

is strongly involved in tourism activities. Our data confirm that a number of households located at accessible places nearby the district center or tourism attractions were successful in the development and marketing of tourism-related products. However, the benefits of the tourism development are concentrated among a small group of rural households. The additional income from tourism allowed them to gain a higher income, adopt a higher living standard and invest more in the education and training of the next generation. They also invested in modern agricultural practices leading to agricultural intensification and abandonment of steep uplands.

Tourism development can be a factor in land abandonment, provided that it allows rural households to generate sufficient additional income. If the added value from tourism-related activities is not sufficient, land abandonment is limited. While an appropriate solution is required to involve local people in tourism by, e.g., improvement of accessibility, schooling and language skills, alternative livelihood strategies are needed in remote villages. Intensification of farming activities with production of market-oriented crops to supply the tourist demand might be an alternative way to raise the income levels of impoverished rural households.

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